Participative design of participation structures: a general approach and some risk management case studies

Chabane Mazri, Bruno Debray, Myriam Merad, Alexis Tsoukiàs

Laboratoire d'Analyses et Modélisation de Systèmes pour l'Aide à la Décision
UMR 7243

Octobre 2012

Participative design of participation structures: a general approach and some risk management case studies

Ch. Mazri, B. Debray, M. Myriad, A. Tsoukias

Participative design of participation structures: a general approach and some risk management case studies

Chabane MAZRI[1], Bruno DEBRAY[1], Myriam MERAD[1] and Alexis Tsoukias[2].

e-mail: Chabane.mazri@ineris.fr

Tel : +333 44 55 62 56

Fax : +333 44 55 62 95

[1] *INERIS. Parc Technologique ALATA. BP2. 60550 Verneuil en Halatte, France.*

[2] *LAMSADE. Université Paris Dauphine. Place du Maréchal de Lattre de Tassigny, Paris, France.*

Abstract

Organising participation of multiple stakeholders is nowadays a widespread request in decision processes, especially for organisations managing environmental risks. Therefore, analysts delivering decision support are expected to provide decision makers with scientifically sound and practically realisable approaches regarding this issue. One of the main challenges in dealing with participation is the definition of the organisation, the so called participative structure, through which stakeholders will contribute and interact during the decision process. Who should participate when and according to which rules are the main questions to be answered. Stakes associated to this challenge are of extreme importance for decision makers since decision legitimacy and acceptance strongly relies on the ability to demonstrate a real transparency and information disclosure during the whole decision process.

This paper proposes the iterative comparison approach as a new and original frame to be used by an analyst supporting a client dealing with such questions. Through an unambiguous definition of cognitive artefacts to be constructed when designing participative structures, this paper provides a clear framework that organises an analyst intervention in participative contexts. Furthermore, it offers the opportunity to design tailored participative structures that integrate context specificities in one hand, and satisfies quality criteria being fairness, competence and efficiency on the other hand.

Keywords

Decision aid, participative structures, Industrial risk management.

Introduction

Participation is defined as Forums for exchange that are organised for the purpose of facilitating communication between government, citizens, stakeholders and interest groups, and businesses regarding a specific decision or problem (Webler and Renn, 1995). Our modern democratic societies are showing an increasing interest towards participation based approaches where each and every stakeholder, especially the general public, may ask for the legitimacy to influence the final outcomes of a decision process. Several regulations and incentives have been adopted in that sense. Without being exhaustive, 39 European countries ratified the Aarhus convention (1998) which enforces for every citizen the rights of access to information, public participation in decision making and access to justice in environmental matters. The ISO 26000 (2010) norm on Corporate Social responsibility (CSR) explicitly values community involvement and development as a key process for organisations. In this new deal, both public and private decision makers (DMs) are asked to disclose their decision processes and seek, in addition to the classical technical validity requirements, for more legitimacy and acceptability for their decisions. Here again, we assist to a shift from a legitimacy considered as inherent to decision power or to natural attributes as defined by Weber (1922) to the need of a legitimating process where a DM has to negotiate with stakeholders in order to build the normative system required by his action (Laufer,1996). This makes decision processes more costly and more vulnerable. More costly because organising public participation, preparing to challenging expertise, dialoging with non technical stakeholders or dealing with conflicting value systems require specific expertise, additional efforts and extends decision delays (Mazri, 2007); more vulnerable because disclosing complex or uncertain issues may trigger outrage (Sandman,1993), conflicts and deteriorate relations between stakeholders (Rowe and Frewer, 2000) with potentially catastrophic consequences for the decision process and the DM.

For these reasons, managing stakeholders' participation definitely entered the sphere of responsibilities of a DM, and consequently, the sphere of competences a provider of decision support, so called the analyst, should develop.

Historically, decision support has been interested in rationalising organisations through mathematically based optimisation models. This tendency for systematic quantification of social sciences (Bouyssou, 2003) has been strongly criticised (Sfez, 1992), (Scharling, 1985), (Rosenhead and Mingers, 2004), (Roy,1994) Ackoff (1979), especially because its inability to cope with both limited rationality of DMs (Simon,1954) and multiplication of interacting rationalities within decision processes. In order to overcome what Ackoff (1979) called *contextual naivety*, decision support shifted towards a constructivist vision (Roy and Bouyssou 1993; Roy, 1994; and Tsoukiàs 2008) where the problem to be resolved is no more an objective truth to be found somewhere within the DM's brain but a complex and subjective construction which components may be provided by the DM as well as experts or interested parties. Therefore, the analyst is also interested in rationalizing the way various contributors may shape the definition of the problem to be resolved.

According to the above, rationalising the way various stakeholders may interact within a decision process becomes a focal point for both DMs and the analyst. Basically, this rationalisation requires the definition of an organisation composed by a set of stakeholders which interactions are framed according to a set of rules. In the following, we will refer to such an organisation through the term *Participative structure*.

Several participative structures have already been defined and tested in the literature. Consensus conferences (Nielsen &al, 2006), Grundahl (1995); deliberative polls (Crosby, 1996), (Fishkin, 1995); citizen juries (Dienel and Renn, 1995), (Coote and Lenaghan, 1997) or analytic deliberative processes (Renn, 1999) are examples of widely used participative structures. Given the limits and strengths of each of those participative structures, one can argue that rationalising stakeholders' participation can be formalised by an analyst as a problem of selecting the most suitable participative structure regarding the specificities of a context in one hand, and DM's preferences and needs on the other hand.

However, we believe that standing for such a problem formulation raises the following limits:

- Selecting one or several predefined participative structures has a perverse consequence, being the analyst forcing the context to fit into a participative structure instead of the inverse. Adopting such an approach would backward decision support to its old mistakes that Ackoff (1979) had perfectly summarizes by noticing that *OR was dictated by the nature of the problem situations it faced, now increasingly, the situations it faces are dictated by the techniques at its command.*
- Some contexts may be constrained by several technical or regulatory requirements which no predefined participative structure can fit. The experiment conducted in France and described later on in this paper describes perfectly this situation.

In order to overcome these limits, we suggest, when dealing with participative structures, switching from a selection process to a design one. Basically, the aim of this paper is to present a methodological approach on which an analyst could rely to design original and context adapted participative structures when providing decision support for a DM. By doing so, the analyst can expand the scope of its "classic" products being problem formulation and evaluation models, to propose participative structures which increase legitimacy of the decision processes and acceptability of its final outcomes.

The paper is organised in four sections. The first one introduces some preliminary concepts and definitions to be used in the following. The second proposes a conceptual definition of participative structures that describes the cognitive products each DM should expect from an analyst designing participative structures. The third section presents the methodological approach to design such cognitive products whereas the fourth and last section presents a three years experiment in the field of risk management and land use planning around hazardous plants in France after the 2003 TOULOUSE catastrophe.

1. Preliminaries

In the following we introduce some definitions associated to a set of key terms and concepts the reader will regularly meet in this paper.

- *Decision process:* a sequence of interactions amongst persons and/or organisations characterizing one or more objects or concerns ("the problems"; Tsoukiàs, 2007)
- *The client:* An actor in a decision process who asks for a support in order to define his behavior in the process (Tsoukias, 2003). In our case, the client is the stakeholder in charge of defining the participative structure, who can be either the same or different from the final DM. For instance, the L95-101 act in French regulation has created a *National Commission of Public debate* in charge of organising public participation regarding projects considered as of strategic importance (National

infrastructure, new technologies applications…). This commission has no decision power; its only objective is to organize stakeholders' participation and draw out a set of recommendations and potential conflicting issues. In other cases, our client and the final DM can be one and unique stakeholder as it will be the case in the application described in the last section of this paper.

- *Decision aiding process :* The interaction initiated and organized by the analyst with the client and every stakeholder considered as relevant for the purpose of supporting the client in all steps of the decision process. As stated by Tsoukiàs (2007), the main object of this interaction is the establishment of some shared cognitive artefacts. Decision support can thus be defined according to the products (cognitive artefacts) it generates through its various phases.
- *Participative decision process:* We will consider a decision process as participative if one of the following conditions is fulfilled:

- The decision power is shared, equally or not, among various stakeholders. Consequently, multiple DMs are to be considered.
- A unique DM is identified but other stakeholders may have significant influence on the way decisions are taken or implemented once taken. In such a context, the DM is interested in involving one or several of those influencing stakeholders.

  Actually, this second type of situations is much more frequent and difficult to characterise than the first type. For the sake of clarity, we will consider in the following as influencing any stakeholder which resources may enhance or reduce the decision process ability to fulfill one or several of its objectives. The objectives we are talking about here can be of extremely various natures as described by Bayley and French (2007) (see fig.1 below).

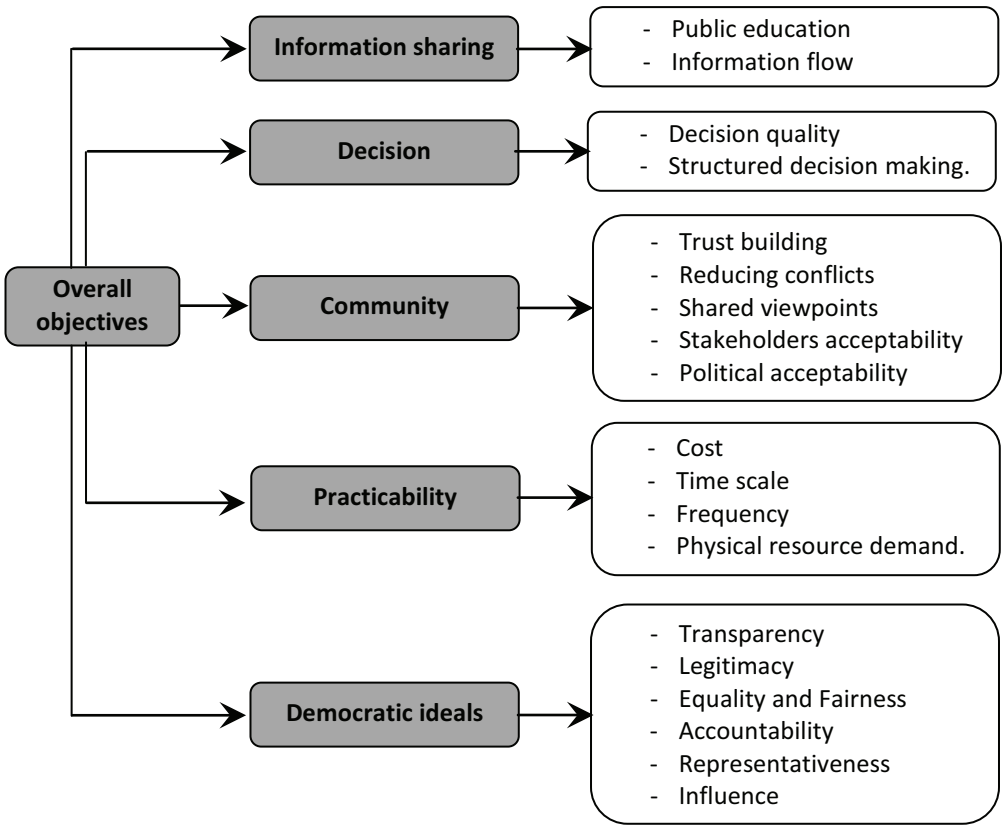


Figure 1 Objectives potentially associated to a participative process (inspired by Bayley and French, 2007).

- *Problem formulation:* A formal representation of the problem for which the client asked the analyst to support him (Tsoukias, 2007).
- *Debate objects:* Issues, concerns or topics that compose the problem formulation. Those objects are matter of interaction within the participative structure.
- *Stakeholder's resources:* The variety of potential objectives described above is the natural reflect of the variety of resources' types each stakeholder may bring within the participative structure. Within this paper, we suggest to consider the following resources when characterising the potential influence of a stakeholder on a decision process:
    - *Scientific and local knowledge*. The definition of scientific knowledge is a vast philosophical and epistemic debate that goes far beyond the purpose of this paper. Our claim here is that scientific knowledge, defined as *shared beliefs satisfying the specific (epistemic) criteria of an (epistemic) community* (Van Dijk, 2003), should not be the only type of knowledge to be recognized as a resource when dealing with stakeholders' participation.

      Communities may develop context specific knowledge resulting from long experience and interaction with a considered system. Even if this knowledge has not proven any validity according to epistemic criteria, it may bring for its specific context relevant insights and complementarities to scientific and theoretical knowledge. In literature, various terminologies are used to describe this form of knowledge: local knowledge (Corburn, 2003), contextual intelligence (Fischer, 2000) or indigenous knowledge (Agarwal, 1995).
    - *Legitimate systems of beliefs and values*. Keeney (1996) defines values as *principles used for evaluation (of the actual and potential consequences, alternatives and decisions). They range from ethical principles that must be upheld to guidelines for preferences among choices*.

      Since systems of beliefs and values are unavoidable shaping factors of each decision process, involving stakeholders with legitimate values regarding the potential outcomes will improve the legitimacy of the whole decision process.
    - *Economic resources:* Every resource with economic value that may improve the progress of the decision process through better implementation of its various phases or by widening the spectrum of economically feasible alternatives.
    - *Representativeness.* A stakeholder considered as legitimate to represent one specific population or group of interest possesses an important resource to enter the decision process and influence on its progress, and potentially, on the acceptability of its final outcomes. Representativeness can be legal if regulation gives official attributions of representativeness to a stakeholder such as mayors or unions; it can be moral if a category of stakeholders trusts or recognizes the authority of one representative. It can also be de-facto if a stakeholder occupies the arena for a long term on a special topic.

The key concepts required in order to present our approach are now introduced. In the next section, the reader will find a definition of participative structures according to the cognitive artefacts that compose them.

2. Participative structures: A conceptual definition

We emphasized earlier in this paper that decision support is defined according to the cognitive artefacts it generates. Consequently, supporting decisions through the proposal of participative structures needs to be performed according to a set of shared cognitive artefacts.

Artefact 1: Stakeholders' identification {A}

The great variety of potential objectives associated to a participative decision process (as described in fig.1) and of resources each potential stakeholder may bring in would be an incentive to disclose as much as possible the decision process. Obviously, the more we disclose the decision process, the more likely we include required resources (both in terms of quantity and variety) to cope with the decision process challenges. Nevertheless, each additional stakeholder represents a cost for both the client and all the other stakeholders:

- The more the process is disclosed, the more it becomes complex and expensive for the client to ensure that all required conditions are set to allow participants understanding the issues considered as well as other participants' rationalities.
- For all the participants, each additional stakeholder implies a potential need to invest more resources (time, additional knowledge…) in understanding its rationality and language.

For these reasons, it is of vital importance for the client and the analyst to seek a subtle balance between disclosing the process and keeping it in a manageable format. We will consider this dynamic and contextual balance as the first cognitive artefact to be built in our decision support process.

In addition to that, we have to acknowledge that the assessment of stakeholders' resources needs to be performed according to a problem formulation. In other words, we should know what the problem is in order to evaluate the adequacy of stakeholders' resources with the issues to be discussed. However, if the problem formulation influences the set of stakeholders to be included, each stakeholder in return influences the problem formulation by bringing in challenging problem formulations, new issues to be discussed or new decision criteria.

This first artefact {A} is thus strongly correlated with the need to identify the debate objects that compose the problem formulation.

Artefact 2: Debate objects to be discussed within the decision process {Θ}

If participative structures need to fit the set of stakeholders and their specificities, they have also to take into account the properties of the issues, problems and topics (called in the following *debate objects*) to be discussed within the decision process.

One can find in the literature various properties of the debate objects that may influence the way deliberations should be conducted. Chess, Dietz and Shannon (1998) distinguish debate objects according to two properties:

- *Convergence level of value systems:* Deliberations about an object may raise various value systems which divergence level would modify the way deliberations should be conducted.

- *Knowledge controversy levels:* Level of scientific controversies related to an object should influence the way deliberations are conducted.

Renn and Klinke (2002) have also emphasized the fact that, depending on the complexity and ambiguity levels of issues considered during risk management processes, stakeholders will be using different types of discourses which may require different types of stakeholders and, consequently, different types of participative structures. A continuous scale distinguishing simple, complex, uncertain and ambiguous risk issues is used to induce various types of discourses, respectively, instrumental, epistemological, reflective and participative, and consequently, different participation contexts as described in fig.2.

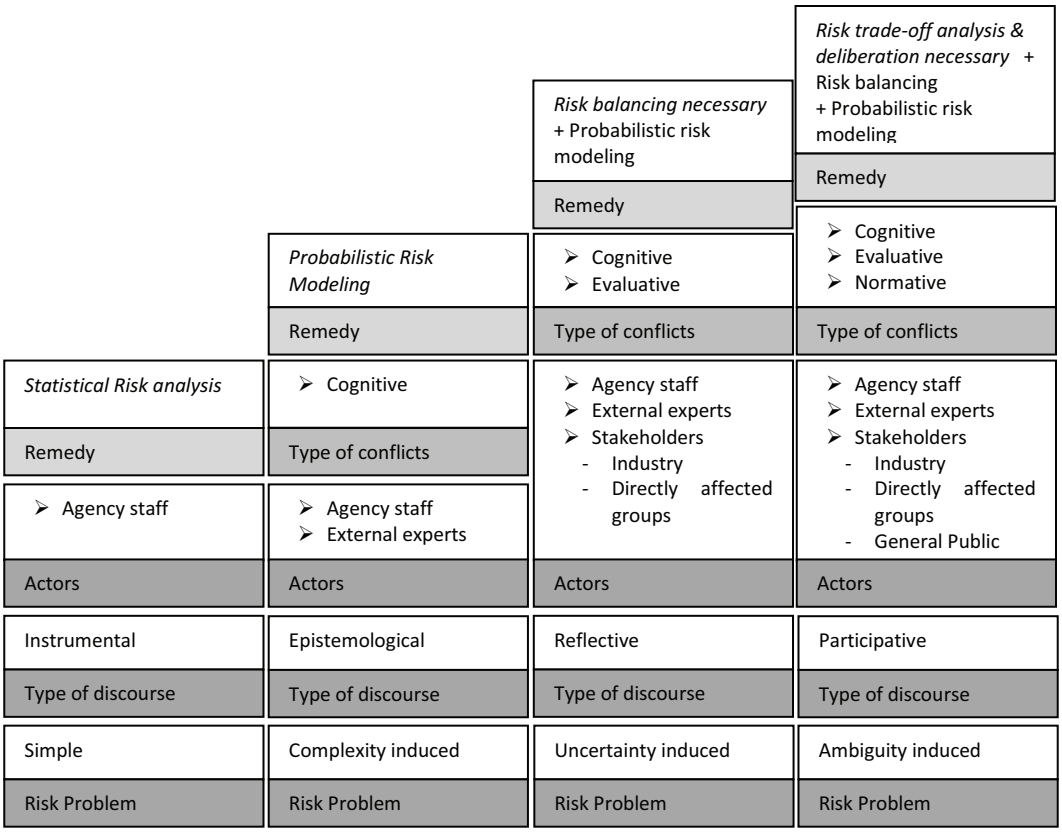


Figure 2. Risk management escalator according to Renn and Klinke (2002).

These models reflect a relative consensus in literature on the fact that objects' properties should influence the definition of participative structures. Furthermore, we believe that the early recognition of debate objects we suggest through this artefact provides the client with the following benefits:

- It ensures that various expertise and knowledge required for an informed decision making are identified as early as possible to ensure their availability when required.
- Every additional object identified at this level may require further disclosure of the decision process to ensure that all relevant stakeholders regarding a specific issue will be available and participating.

Artefact 3: Participation types for each stakeholder {Γ}

The literature has been prolific in distinguishing and characterizing different types of participation according to various criteria. Arnstein's ladder of participation (1969) focuses on the distribution of decision power through participants to distinguish various types of participation (fig.2). Low participation types defined as "*therapy*" and

"*manipulation*" reflects a strong preference for higher participation types and declines any positive impact for the lower ones.

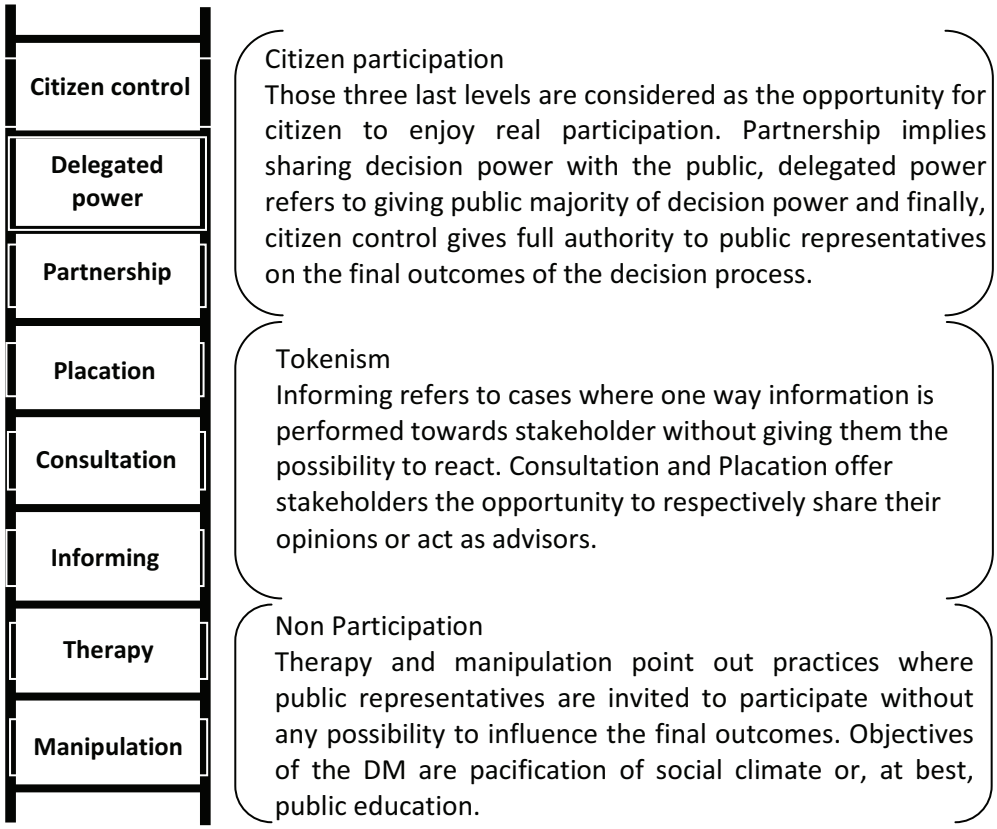


Figure 3 Anrstein's ladder of participation (adapted from Arnstein 1969)

Several other typologies based on various criteria to distinguish participation levels have been suggested after that (Aggen, 1983), (Praxis, 1988), Connor (1988), Wiedemann and Femers (1993), (world bank, 1990), OECD (2001) . Most of such typologies acknowledge the relevance of each participation type or of a combination of them depending on application contexts.

Table 1 below summarizes a few examples of those typologies and the distinction criteria associated to them.

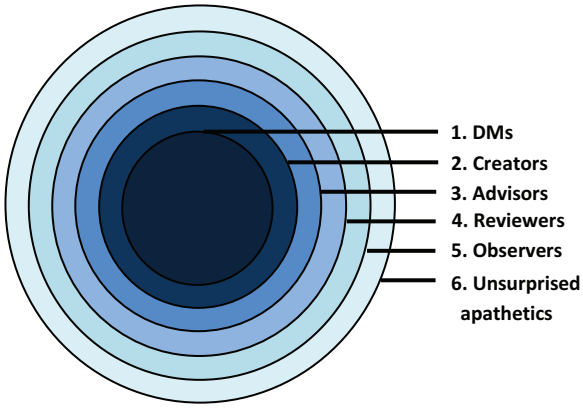
Authors	Distinction criteria	Participation levels
Aggen (1983)	Considering the energy required by each stakeholder to sustain his participation level, Aggen (1983) distinguishes 6 levels, represented as orbits more or less distant from a nucleus being the decision making process.	
Wiedemann and Femers (1993)	Based on the need to empower individuals and communities, levels of responsibility in decision making as well as availability of information are considered as criteria to distinguish various participation levels.	▪ Public right to know ▪ Informing the public ▪ Public right to object ▪ Public participation in defining interests and determining the agenda ▪ Public participation in assessing risk and recommending solutions ▪ Public partnership in the final decision.
OECD (2001)		▪ Information ▪ Consultation ▪ Participation
Connor (1988)	Levels of participation are distinguished according to their ability to deal with various levels of dispute resolution.	▪ Education ▪ Information feedback ▪ Consultation ▪ Joint planning ▪ Mediation ▪ Litigation ▪ Resolution/prevention

Table 1 Typologies of participation levels.

Within this work, we suggest to focus on the following four participation types (see Mazri, 2007; Daniell, 2008; Daniell et al., 2010):

- *Type 1: One way information.* For the purposes of education or awareness rising, information can be provided to stakeholders without offering the possibility of gathering feedbacks.
- *Type 2: Information and feedback.* Two way information channels are set between decision makers and other stakeholders.
- *Type 3: Consultation.* Stakeholders are explicitly asked to express their opinions and views when possibilities to modify the project outcomes are still available. DMs remain nonetheless free to take into consideration these opinions.
- *Type 4: Involvement in decision making.* This level encompasses all forms of decision power sharing between stakeholders.

We assume that:

- these various types can be combined at different moments of the decision process;
- each stakeholder may have different participation types depending on the issues considered or on the decision process steps;
- Each of these types may encompass a wide range of techniques and approaches. The selection of the adequate methodology to implement each participation type is a context based decision that goes beyond the artefact described above.

Artefact 4: Participation objectives {Ψ}

Objectives associated to a participative structure define its identity. As described in fig.1, several distinct objectives and motivations can lay behind the willingness to crate or enter a participatory decision process. Yet, a key issue is the possibility to harmoniously combine various objectives brought by various stakeholders within the same decision process. For instance, how to combine implementation of democratic ideals (decision power sharing, representativeness, fairness…) through involvement with education objectives through one way communication?

Actually, many of our observations of conflicts regarding industrial risk management in France (see real case experiment in chapter 4) emerge from a strong disagreement on the very objectives of the participatory decision process.

It is thus of obvious importance for the analyst to ensure that he provides adequate decision support for the construction of a shared representation of the objectives to be associated to the participatory decision process.

Formal definition

According to the above, we will consider in the following that a participation structure is a quadruplet $P = < A, \Gamma, \Theta, \Psi >$:

- P: Participative structure.
- A: Set of stakeholders within the decision process.
- Γ: Set of participation types of every stakeholder.
- Θ: Set of objects to be dealt with during the decision process.
- Ψ: Set of objectives associated to the participative structure.

It is important to note that these four artefacts are (i) mutually interrelated and (ii) dynamic. More precisely, none of these four artefacts can be shaped independently from the three others. Basically, the set of stakeholders influence and is influenced by the set of objects. The participation types affected to every stakeholder depend on their contributions to every object. The set of objectives will depend on the stakeholders and objects to be discussed. Furthermore, each of those artefacts can evolve during the decision process in accordance with the evolution of ideas, positions and knowledge of stakeholders. Consequently, the approach suggested in the following will pay attention to constantly acknowledge the dynamic and interrelated characters of the artefacts described above.

3. The Iterative comparison approach

The iterative comparison approach we will be presenting in the following aims at suggesting a methodological frame for an analyst interested in building the above mentioned artefacts. It is based on two key hypotheses that need to be made explicit. The first one is related to the quality objectives we target for each participative structure conceived according to this approach. The definition of those criteria derives directly from the hypotheses we chose to adopt when it comes to the definition of a good participative structure. Making explicit this hypothesis is fundamental in order to help the analyst justifying the relevance of participative structures conceived according to this approach comparatively to any other randomly selected ones.

The second key hypothesis is related to the descriptive model on which we rely to characterize stakeholders interactions within a participative decision process. As stated previously, we adopt a constructivist vision of decision support where each stakeholder may bring a piece of the puzzle to perform artefacts construction. Ostanello and Tsoukias (1993) proposed the Interaction Space model to describe how this construction is performed in participative contexts. We will briefly present this model and describe how it fits our needs.

Key hypothesis 1: Quality criteria for participative structures

Rationalising decision making is the main challenge of each analyst. In designing participative structures, the act of rationalisation is performed through the ability to demonstrate how the designed structure provides interacting stakeholders with the best debate conditions, regarding context specificities. The issue of rationalisation is thus intimately linked to the definition of standards of satisfactory debate conditions.

In order to settle such standards, we appeal for the founding and prolific work of Habermas (1987) (1992) related to communicative rationality. When treating the issue of norms and procedures by which communication between stakeholders can be organised, Habermas proposed a set of conditions to be respected in order to reach what he called an *ideal speech situation*. The term *ideal* here refers to a perfect but theoretical set of conditions to be enforced if one wants to offer a satisfactory framework for a debate.

According to Habermas, offering an ideal speech situation requires the satisfaction of two criteria: **fairness** and **competence**.

Fairness refers to the ability to offer comparable chances to access the debate for all stakeholders. Habermas suggested some clear recommendations on how to implement such a criterion:

- all stakeholders have equal rights to attend the debate;
- all stakeholders have equal rights to express and defend their claims;
- all stakeholders have equal rights to contest claims presented by other participants to the debate;
- All stakeholders have equal rights to define decision rules and validation procedure in case of lack of consensus.

The criterion of competence imposes some requirements to the stakeholder interested in participating to the debate. Those requirements are (see also Watzlawick 1967):

- *Cognitive competence,* addressing the ability to develop a logical reasoning.
- *Linguistic competence,* addressing the ability to formulate in a comprehensive manner a logical reasoning.
- *Pragmatic competence,* addressing the ability to use language effectively in order to achieve a specific purpose and to understand language in context.
- *Interactional competence,* addressing the ability to understand and use interaction rules and norms.

Practical recommendations described above are just examples of how such criteria can be translated operationally. Actually, there has been an important discussion on the interpretation and signification of these criteria (Webler, 1995).

Without any pretention of being exhaustive, we propose to value this discussion in the decision support domain as follows:

- Fairness and competence need to be understood as complementary. They both contribute to shape the space of acceptable participative structures exactly the same way that various linear constraints contribute to shape the space of realizable solutions in a linear programming problem. Considering separately one or the other of those two criteria will lead to an unlimited set of realizable solutions in terms of participation structures.
- As recommended by Webler (1995), we will acknowledge in the following that competence should be considered as a property of the participation structure and not only of the participants.

  In other terms, more than asking for competent participants, the way participation should be organized must support the availability of best and understandable knowledge for all participants.
- As recommended by Webler and Renn (1995), effectiveness could be considered as a third criterion to appreciate the quality of participative structures. Described as the ability to achieve the objectives devoted to the participation structures using the minimum amount of resources, we propose to consider this third criterion as an objective function that orients the research for a good solution within the space of realisable participative structures.

To summarise, we will consider in the following as standards of good debate the need to elaborate participative structures that promote fairness, competence and effectiveness. Actually, the suggested methodology should be considered as a mean for an analyst to ensure a correct implementation of these standards in his intervention.

Key hypothesis 2: The Interaction Space model

Ostanello and Tsoukias (1993) defined the concept of *interaction space* (*IS*) as an informal and abstract structure which facilitates interaction between actors with the aim of confronting their respective rationalities and enhance communication. Conceived as a soft tool to describe and understand the dynamics of interaction between stakeholders, the authors distinguished several states of the IS to be acknowledged when an analyst provides decision support. Controlled, non controlled expansion or stalemate are examples of the various states each IS can experiment and which, in return, should be considered by an analyst to calibrate its decision support.

The original concept of IS has two major implications for our work. First, we can consider the four artefacts suggested earlier as means to organize an IS by defining entrants (A: set of participants and Θ: Set of objects), prescribing a set of interaction rules (Γ: participation levels) and affirming an identity (Ψ: Set of objectives). Second, Ostanello and Tsoukias (1993) remind us that stakeholders entering an IS may occupy different positions in the space, depending on their resources and relationships with other stakeholders. Therefore, each stakeholder needs to be fully characterised in order to better understand the various positions he may occupy in the IS.

To better fit this requirement, the artefact <A: set of participants> needs not only to detail the list of stakeholders, but also to characterize them through a descriptive model. In the following, we suggest to describe each entering stakeholder through the following descriptive concepts:

- *Intrinsic characterisation:* includes the descriptive items of a stakeholder that contribute to shape his representation of the problem situation which, in consequence, determines his position within the IS. We suggest to focus our attention on the following two items:
    - *Set of resources*: We detailed earlier the typology of resources we suggest to consider when characterizing each stakeholder: scientific and local knowledge, legitimate systems of beliefs and values, economic resources and representativeness.
    - *Set of stakes*: A stakeholder may enter an IS to defend or promote various explicit or implicit stakes. Stakes can be of various natures: economic, social, cultural, ethical, political…
- Extrinsic *characterisation:* By opposition to the intrinsic characterization which contributes to shape the representation of the problem for given stakeholder, extrinsic characterisation describes the problem representation of each stakeholder as he projects it within the IS. In other words, the extrinsic characterization describes the "visible" aspects of the stakeholder's problem representation whereas intrinsic characterisation is interested on the more implicit aspects that contribute in shaping this problem representation.

According to the above, we suggest modeling the stakeholder's problem representation through the three following items:

- *Objects to be discussed within the IS*: We are here interested in describing the messages, issues, problem formulations, new alternatives or evaluation criteria a stakeholder wants the other stakeholders to explicitly consider within the IS. Treating these objects may be the main motivation for a stakeholder to enter an IS. For instance, asking to consider explicitly the alternative of closing up a hazardous site instead of studying exclusively risk mitigation measures can strongly reshape the list of issues to be discussed within an IS.
- *Stakeholders to enter the IS:* To consider an IS as legitimate and adapted to the set of objects he wants to discuss, a stakeholder may ask to include other stakeholders in the IS. The most common example of such demands is the requirement for additional or independent expertise for a specific issue. More generally, asking for more disclosure is a mean for stakeholders to assess the openness of decision makers, and consequently, the trust they can place in the IS.
- *Objectives associated to the IS:* As stated in table 1, participation can be performed to achieve several objectives, some of them being potentially conflicting. For example, if a decision maker enters an IS with the objective of informing and educating the

public whereas other participants expect to influence the final decision outcomes through the IS, a strong conflict on the IS identity rises very quickly. It is thus important to acknowledge, very early in the decision process, the objectives of each stakeholder regarding the IS.

Regarding the concepts of intrinsic and extrinsic characterization described above, we will model a participatory decision process as *the creation of a formal or informal interaction space within which each stakeholder projects its actual*[1] *problem representation previously shaped by its resources and stakes (intrinsic characterization) and materialised through the set of objects, stakeholders and objectives (extrinsic characterization) he projects within the IS. According to that, the analyst intervention consists in organising, to a certain extent, the IS through the quadruplet of artefacts* $< A, \Gamma, \Theta, \Psi >$.

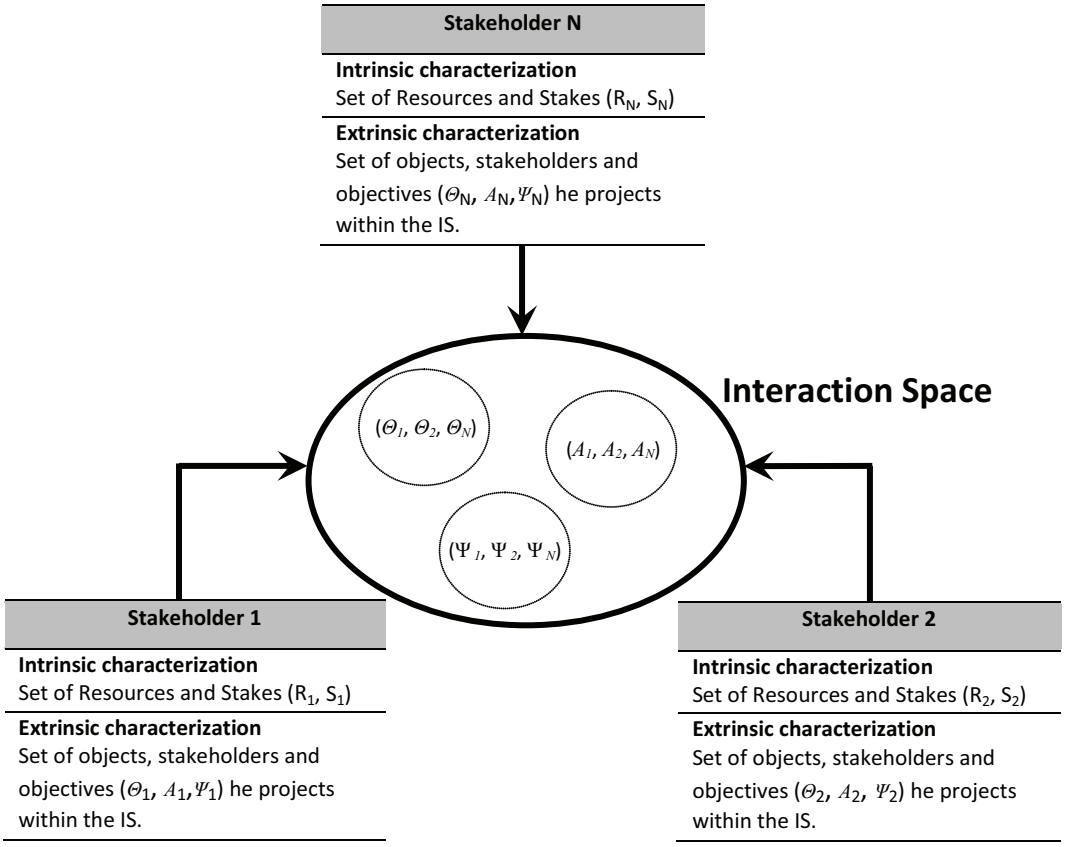


Figure 4 The Interaction Space model

Now that the key hypotheses are introduced, we will detail in the following the operational steps composing the iterative comparison approach

[1] In the sense that a stakeholders projects the actual state of his problem representation that has evolved and will continue to evolve through either his interactions with other stakeholders or through the evolution of his resources and/or stakes.

Detailed operational steps

Building shared cognitive artefacts on the basis of multiple problem representations has been explored by decision sciences, especially in the frame of the so called problem structuring approaches. Strategic Option Development and Analysis (SODA) (Eden and Ackermann, 2002), Soft System methodology (SSM) (Checkland, 2002) are examples of existing approaches where several problem representations where to be described and combined to build new and better understanding of problem situations.

Usually based on *less complexity and more participation* (Rosenhead and Mingers, 2002), these approaches avoid the use of abstract and complex languages (less complexity) to ensure more openness and participation for the various stakeholders. This principle fully applies in our case regarding the need for stakeholders' inputs to build the requested artefacts.

Basically, the analyst needs to explore the richness and variety of stakeholders' inputs in an organised and systematic way so to build artefacts that respect the quality criteria described earlier: Fairness, competence and effectiveness. To do so, we suggest in the following to adopt an innovative approach called iterative comparison.

The first material of the analyst will be the initial problem representation of the decision maker, i.e. how the decision maker would build the artefacts < A, Γ, Θ, Ψ > without any decision support. The analyst intervention will consist in enriching and structuring this problem representation by systematically comparing it with other stakeholders' representations and identifying space for improvement regarding the quality criteria (Fairness, competence and effectiveness) described above.

Each comparison is considered as iteration in the process of building the artefacts as shown in fig.5 below.

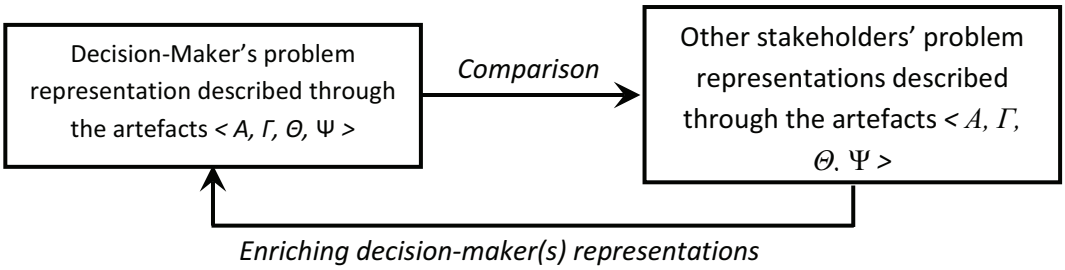


Figure 5 Iterative comparison principle

The translation of this principle into practical steps is described in the following.

Step1: Client's problem representation

The analyst performs an intrinsic and extrinsic characterization of the client. Through the intrinsic characterisation, the client's resources and stakes (Ri, Si) will be described, making it easier for the analyst to understand his expectations of the forthcoming decision process. Extrinsic characterisation (A, Θ, Ψ) will provide a description of his problem representation, which will be the first set of artefacts introduced within the interaction space.

Step2: Focusing on the objects

The set of objects Θ is one of the artefacts provided by the client during the first phase. It describes the issues, problems and messages the decision maker wants to share and discuss within the IS. This second step is dedicated to a deep exploration of the meanings and dimensions associated to these objects in order to:

- Describe the resources required to debate on those objects during the decision process. These resources could be, as described earlier in this document, of various natures: scientific and local knowledge, representative systems of values and beliefs, representativeness or economic resources.
- Describe the stakes that could, positively or negatively, be impacted by these objects. Decision processes need usually to manipulate objects which transformation may affect or be affected by several stakeholders (Ostanello and Tsoukias, 1993). This contingency of objects makes it necessary for the analyst to perform this exploration effort far beyond the client's proper stakes.

This step is an anticipation exercise to be performed by both the analyst and the client to understand the consequences on the decision process of including or excluding a specific object from the IS.

Step 3: Assessment of participation types

The IS is now filled with a set of objects. Regarding the resources required to explore them and the stakes they potentially impact, this step aims at determining a first set of stakeholders to join the IS and the participation types to be suggested to them.

Hereafter two distinct rules, based on competence and fairness, are proposed in order to assess the legitimacy of stakeholders to enter the IS:

- *Competence*: Can enter the IS all stakeholders that prove having one or several of the resources required to debate on one or several objects of the IS.
- *Fairness*: Can enter the IS all stakeholders interested in one or several of the stakes potentially impacted by one or several objects of the IS.

Each stakeholder considered as relevant according to the rules described above should be offered the opportunity to enter the IS. The reader may note that we do not consider, at this moment, any efficiency constraint when it comes to opening the gates of the IS to participants.

In order to associate participation types to each participant, the analyst and the client need to develop a coherent and legitimate set of rules that can be made transparent and understandable for the future participants.

We suggest using the following rules as a basis for this discussion:

- A stakeholder with high level of stakes and resources should be offered the opportunity to be *involved*.
- A stakeholder with a high level of resources and a very low level of stakes should be offered the opportunity to be *consulted*.
- A stakeholder with high level of stakes but low level of resources should be regularly informed and his feedbacks collected and shared within the IS.
- A stakeholder with low levels of stakes and resources should be informed.

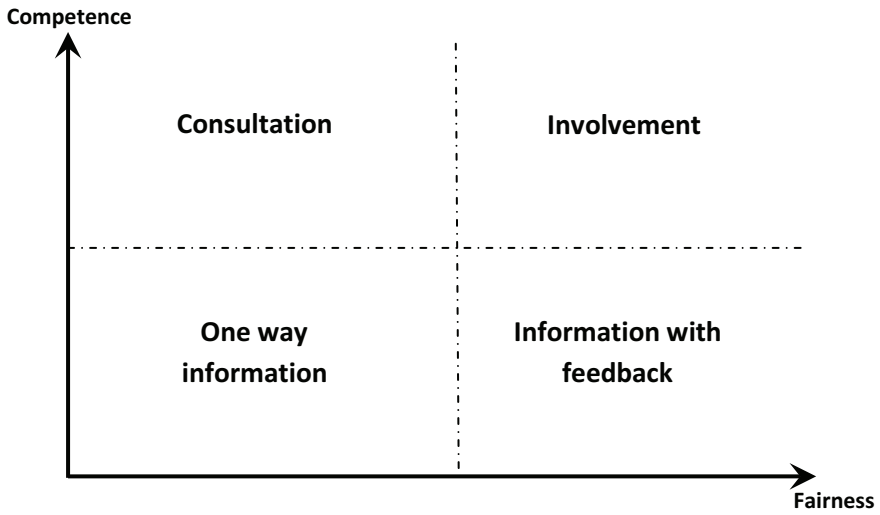


Figure 6 Stakeholders' participation types regarding the issues of fairness and competence.

Considered together, the set of rules described above is a soft approach aiming to help the analyst and the client suggesting legitimate and transparent participation types to stakeholders entering the IS.

The following recommendations are to be considered when using this soft approach:

- A stakeholder entering the IS may have different participation levels depending on the objects. Actually, he can be consulted for one object, involved for another and informed about a third one. Participation becomes thus more dynamic and adapted to the objects' properties.
- Separation axes used to separate the various types of participation in fig.6 are a translation of fairness and competence criteria described earlier. Regarding competence, one can note that the more stakeholder resources are high, the highest is his participation type (horizontal separation axis). Regarding fairness, the more stakeholders' stakes are impacted; the highest is their participation type (Vertical separation axis).
- Separation axes should not be understood as rigid frontiers hindering communication. Actually, rather than constraints, they should be used as means to relax the problem and easily adapt to contexts. For instance, suppose that an important constraint of the decision process is the very limited amount of resources (short delays, low logistic resources…). The analyst can move the separation axes (the vertical to the right, the horizontal to the top) and limit involvement and consultation to fit resources constraints. On the other hand, if the decision process is offered enough resources, the analyst can suggest more openness and inclusiveness by moving the separation axes appropriately (the horizontal down and the vertical to the left).
- When thinking about participation types to be suggested to stakeholders entering the IS, the analyst and the decision maker should constantly keep in mind that an important objective to reach is the acceptance of these suggestions by future participants. In other words, stakeholders should understand and share, as much as possible, the same vision of their role within the IS. We believe that it is more likely for the analyst to face difficulties reaching this objective when dealing with stakeholders invited to be informed and give their feedback without any sharing of decision power, even if their stakes are highly impacted by the object under consideration. Actually, because of their lack of resources (competence criterion),

those stakeholders are not given the opportunity to share decision power. Instead of that, they are asked to trust other categories of stakeholders (involved and consulted) to take account of their feedbacks and take the right decisions. Trust being a rare commodity, especially in public decision processes, we suggest the analyst to study the possibility of increasing their resources, and mechanically, their participation types. For instance, dedicated trainings or experts conferences can be organized to increase understanding of technical issues and allow a higher participation type for those stakeholders.

We believe that the following benefits can be associated to the use of this soft approach:

- Adapting the participation types of stakeholders to each object enhances efficiency of resources consumption for participants. They can focus their efforts on issues for which their contributions are valuable and remain informed of developments regarding other objects. Stakeholders' resources, including willingness and motivation to participate being limited, this soft approach offers the possibility for the analyst to use cautiously the stakeholders resources.

  By doing so, we also demonstrate that efficiency should not be always considered as orthogonal to fairness and competence, but could also derive from them. In other words, implementing fairness and competence rules when dealing with participation can also improve decision process efficiency.

- Satisfying democratic ideals through total openness of decision processes can be impossible to reach when resources are lacking. The above described approach could be an interesting mean to seek a coherent and legitimate balance between openness in one hand and scarcity of resources on the other hand.

Step 4: Stakeholders inputs

Up to now, we used exclusively the client's representation to build a first version of the IS. It is now time to appeal for stakeholders' representations to enrich this first version and ensure that the participation model we are building fits also their needs and expectations.

For the time being we have an IS with a description of objects, stakeholders and participation types associated to them. Two categories of stakeholders have been distinguished: Those with high resources levels (implication and consultation) and those with lower resources (one way and two ways information). Stakeholders with high resources regarding one or several objects will be now asked to provide the IS with their problem representations, exactly as it has been already done with the client. Through intrinsic and extrinsic characterisation to be performed by the analyst, these stakeholders will describe their vision on how the IS should be organized through the artefacts (A, Θ, Ψ). According to the iterative comparison approach described earlier, each of these representations will be then discussed with the decision maker to explore how it may enrich his understanding of the problem and consequently, the IS structure. More precisely, every new object Θ_i, new stakeholder A_i or new objective Ψ_i suggested by a stakeholder should be discussed by the analyst and the client to decide if it should enter the IS or not.

In case of yes, the client's problem representation has been improved as well as the likelihood for the participation model to be accepted by the future participants. A new entrant (Θ_i, A_i or Ψ_i) in the IS implies going back systematically through steps 2 and 3 in order to update the IS organization. More precisely:

- A new object Θ_i implies to assess the resources required to debate about it as well as the stakes potentially impacted. This will in return require affecting participation types to every stakeholder regarding this object.
- A new stakeholder A_i implies to assess his participation types regarding each object. If his resources are considered as high enough regarding one or several objects, his problem representation should be explored and considered within the iterative comparison process.
- A new objective Ψ_i implies to review the general objectives of the IS and potentially, include new objects or stakeholders.

In case of no, both analyst and client should explicitly justify and argue this decision and get ready to explain it and defend it in front of the stakeholders.

As long as new artefacts (Θ_i, A_i or Ψ_i) enrich the client's representation and enters the IS, this cyclic process needs to carry on in order to reshape in an organised and transparent way the participative structure. This cycle ends when both the analyst and the client agree that no new significant artefacts (Θ_i, A_i or Ψ_i) are suggested by the stakeholders.

At this very moment, we will consider that the artefacts A (set of stakeholders), Ψ (set of objectives) and Γ (participation types associated with each stakeholder) are finalised. They have been built according to the contributions from the client and the stakeholders considered as competent.

Step 5: Organizing the set of objects

The artefacts A, Ψ and Γ provide a description on who should participate and how regarding each object of the set Θ. We now need to describe how these various objects will be considered all together within the same IS. More precisely, we need to know if there is any logical sequence to respect when treating each objects. In other words, is it necessary to debate about some objects before, after or at the same time than others?

To tackle this issue, we suggest defining a partial pre order of objects based on a binary reflexive and transitive relation *D* describing dependence between objects. Each couple of objects $(\Theta_i, \Theta_j) \in \Theta^2$ should be analyzed according to *D*. Three possibilities may occur at this level:

- Θ_i *D* Θ_j and $\neg(\Theta_j$ *D* $\Theta_i)$: Θ_i depends on Θ_j meaning that deliberations regarding the object Θ_i rely heavily or totally on the conclusions of deliberations on Θ_j. Practically speaking, this means that deliberations on Θ_j should be organized prior to those on Θ_i. For example, the object "*which risk assessment approach to adopt*" should be debated prior to the object "*how to treat uncertainties and communicate about it*".
- $\neg(\Theta_i$ *D* $\Theta_j)$ and $\neg(\Theta_j$ *D* $\Theta_i)$: Θ_i and Θ_j are independent, meaning that these two objects can be treated in parallel, with no correlation constraints. For example, when risk management requires assessment of various alternatives regarding several criteria, each of those assessments can be performed by different expert teams in a parallel way.
- Θ_i *D* Θ_j and Θ_j *D* Θ_i: Θ_i and Θ_j are interdependent meaning that deliberations about Θ_i can hardly be distinguished from those on Θ_j. In this case, we suggest reviewing these objects in order to eliminate at least one of the two dependencies between these objects. For this purpose, the analyst can either regroup them in one single object or crate a third distinct object by splitting Θ_i or Θ_j. The result is reducing the elementary cycles of the relation thus defining a strict partial order

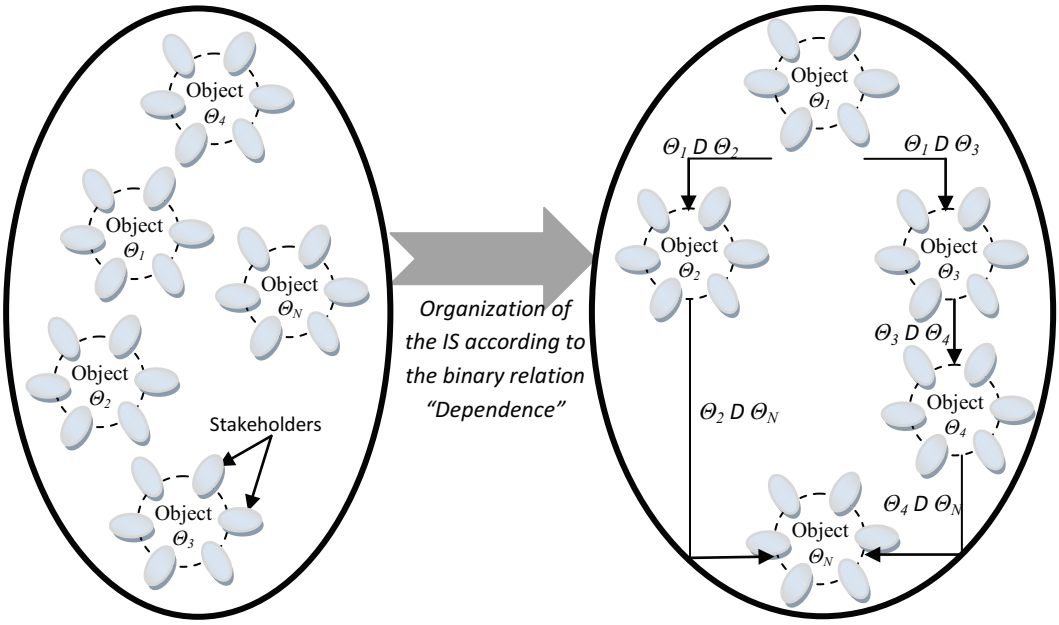


Figure 7 Organization of the objects within an IS according to a *Dependence* binary relation

Ordering the objects offers three main advantages. First, it defines a logic sequence to tackle all the objects of the IS. Second, it identifies objects that can be debated in parallel and thus shorten the global duration of the decision process. Third, it allows the identification of a critical path (see fig.6) distinguishing objects for which delays are permitted and others for which each delay impacts the total duration of the decision process. The two last advantages reflect how the suggested approach improves the participation model regarding the efficiency criterion

Step 6: The IS as a learning tool

Our reflection is grounded in action research as defined by Hatchuel (2000). Therefore, all artefacts described above should not be considered as answers to be rigidly implemented. We recommend to consider them as learning tools helping all the stakeholders, including the DM, to better understand others representations and consider their own ones under a new perspective. In practice, the organisation of the interaction space built according to this approach should be shared with the stakeholders in order to ensure that it correctly fits their expectations. If disagreements occur regarding the position of a stakeholder within the IS, it should be considered by the analyst as an occasion to further explore his problem representation and thus improve the IS organisation against fairness, competence and efficiency criteria. Furthermore, looking for stakeholders' validation of the interaction space before launching the decision process will increase their trust in the willingness of the DM to implement a real participatory process and value their contributions.

Main associated advantages

We believe that the iterative comparison approach detailed above offers the following advantages:

- *The design of a participative structures becomes participative*

  It is ironic to see that participation structures are sometimes imposed to stakeholders. Actually, we believe that offering the opportunity for future participants to contribute shaping the interaction space where their contributions

will be discussed is fundamental to elaborate both “good” and “accepted” participative structures. *Good* because the participation model will be inspired by a large and diverse basis of knowledge and problem representations. *Accepted* because stakeholders will prefer a model where their opinions and representations are integrated.

- *A management tool for the client*

  By implementing the approach suggested above, the client improves his knowledge and understanding of the stakeholders he will interact with. He also improves his anticipation capacities of the issues and questions to be raised. He can thus better adapt and prepare to make his arguments and reflections more understandable by other participants.

  On the other hand, by understanding how their representations fit and interact with others, stakeholders can also better anticipate and organize their resources to ensure that they can correctly present and document their arguments and understand others’.

- *Fairness, competence and efficiency as arguments for a better legitimisation of the participative structure*

  Despite all efforts to build a shared vision of the participative structure, some disagreement may remain irreducible. To build the legitimacy of a participative structure in such contexts, it is necessary for the analyst to seek for other sources of legitimacy than the agreement of stakeholders.

  The ability of a participative structure to demonstrate how it satisfies quality criteria, being fairness, competence and efficiency, could thus be an ultimate source of legitimacy in conflicting contexts. The analyst can rely on these qualities to find an adequate balance between incompatible positions.

4. Application: Risk management of land use around Seveso sites in France

The AZF (Toulouse France) accident in 2001 has put into light situations where everyday activities, including residential areas and transport infrastructures, were authorized in the vicinity of hazardous plants classified as Seveso Tier up[2] according to the European Regulation. The hazards levels imposed to those populations were, after the catastrophe, considered as unacceptable in France and a new risk regulation (2003 Act on industrial and natural risks) was issued in 2003.

This act deeply modified risk management and land use planning around hazardous areas in France by introducing new public decision processes called Technological *Risk prevention plans (Plans de prevention des Risques Technologiques, PPRT).* 420 PPRT are expected to be established in the forthcoming years in France due to this law. The main evolutions introduced by these plans are the following:

[2] Seveso directive is a European regulation (96/82/EC) issued in 1982, modified in 1996 (Seveso II), amended in 2003 and being modified in 2012 (Seveso III). It defines a classification of plants according to the accidental risks they impose to their environment. The Seveso Tier up refers to the most dangerous categories of plants.

- Regarding risk assessment, deterministic evaluations have been replaced by probabilistic approaches and vulnerability assessments introduced. These technical evolutions have deeply changed the way industries assess their risks and led to a dense technical literature. For non expert stakeholders, including citizens and local authorities in charge of land use planning, these technical evolutions created more opacity regarding the difficulty to deal with probabilistic reasoning when building risk perceptions.
- In order to correct local situations considered as unacceptable, various alternatives have been made available. Depending on the hazard and vulnerability levels of each building in the risk area, expropriation or adapted structural reinforcement can be imposed or recommended. Furthermore, future uses of territories impacted by these hazards may be restricted and important economic stakes potentially impacted.
- The *Prefet* (the local representative of the government), assisted by his technical services, is in charge of implementing such decision processes in a participative manner. Actually, according to 2003 act on technological and natural risks, PPRT need to be elaborated through a participative process that welcomes, at least, local authorities in charge of land use planning (mayors and their services), citizens and their representatives, hazardous industries and unions.
- Depending on the type of corrective measures decided, costs can be shared by the government (represented by the "Prefet"), local authorities, industries and owners of constructions impacted (including citizens if homeowners).
- The responsibility to organize and manage stakeholders' participation issued also to the "Prefet" making him a central figure of the arena. Actually, he is:
    - in charge, through its technical services, of hazard and vulnerability assessments. In other words, he provides the IS with the expertise required for decision making;
    - in charge of designing and managing the IS;
    - one of the payers of risk reduction measures;
    - the final and unique decision maker who validates the PPRT;

In order to support the "Prefet" dealing with stakeholders' participation, INERIS (Public research Institute in risk management) was asked by the Environment ministry to develop national guidelines and directly provide decision support in some situations considered as critical because of stakeholders conflicts, important economic stakes or complex territorial mechanisms. For this purpose the iterative comparison approach has been conceived (Mazri, 2007) and six different interventions have been realised according to it. The first one was an experimental case in northern France aimed to demonstrate the feasibility of the approach and evaluate its costs for the client and its services. The results of this experiment were detailed to several representatives of regional technical services during a one day workshop (September 2009) dedicated to public participation.

Globally, the need for a dedicated reflection on participative structures was confirmed and the relevance of our reflection for the PPRT context has been acknowledged by participants. Nonetheless, only two regions confirmed their interest in implementing this approach. We noticed that these candidate regions were facing difficulties or expecting so (as far as participatory aspects were considered). The other regions considered this approach interesting but:

- The participative structure detailed in the experimental study was considered as too much time consuming regarding the resources they expected to dedicate to their PPRT. Once again, stakeholders' participation was given a very marginal amount of resources comparatively to risk assessment phase.
- Regarding how local situations are evolving, those regions' representatives considered ongoing PPRT processes as too much advanced to initiate this kind of approaches. In other words, we arrived "too late". However, they expressed an interest in this kind of reflections for other future public policies during earlier stages, especially when regulation is being elaborated.

Considering the conclusions of this workshop, the ministry acknowledged that interest shown by the two regions as well as the experiment conclusions were positive signals that need to be encouraged. In order to overcome the resource constraint expressed by regions' representatives, the Ministry decided to allocate an annual budget (from 2010 to 2013) to regions interested in implementing this approach.

Three other cases have been conducted in 2011 and 2012. An interesting fact is that one of these three cases was requested by the same client with whom the experimental case was conducted. Actually, his first appreciation on the cost benefit evaluation of this approach being unfavorable was revised after the launching of the decision process and the demonstration that the participative structure suggested was fully justified.

In the following, we will describe the progress of each of the six steps composing the iterative comparison approaches and the lessons learned for each of them regarding the various studies conducted.

Step 1: Elaboration the client's problem representation

A first meeting is organised with the "Prefet" and his local technical services. INERIS being a public organism that has a long tradition of cooperating and supporting Prefet's technical services, we usually already have a global picture of their needs. This first meeting was thus dedicated to detailing local specificities and explaining the approach to our client.

Regarding the first objective of understanding the local context, we usually proceed as follows:

- We go through local historical elements to understand what already happened and collect the client's analysis of the situation. Particular attention is given here to past or ongoing significant conflicts within or outside the PPRT. The existing of open or sleeping conflicts may modify the set of objectives to be associated to the IS.
- We explore all past or existing local participation structures related to land use planning or risk management. This allows us to identify a first set of local stakeholders that have shown an interest and willingness to be involved regarding such topics.
- Hazard evaluation and mapping give a first idea of existing stakes impacted by the PPRT. Each of those stakes is considered regarding the issues it may raise and the stakeholders it may interest. *For example, if a transport infrastructure (highway, railways…) is impacted by the risks, protection and evacuation of the infrastructure become an object of the IS and the organisms in charge of managing those infrastructures are listed as stakeholders of the IS*.

  According to those investigations conducted in collaboration with the client, we define a first set of objects Θ, stakeholders A and objectives Ψ to be associated to the IS.

Regarding the second objective of explaining the approach to the client, we usually rely on operational examples and past experiences to explain how the procedure will be implemented and their expected role.

Lessons learned

Regarding the role devoted to the client during the procedure and decided at this step, we usually insist on the necessity for technical services to participate in stakeholders' interviews in order to (i) create first informal contact and discussions instead of limiting discussions to formal meetings and (ii) ensure that the client's performs the intellectual exercise of confronting his problem formulation with stakeholders' ones. Actually, during the experimental case, the client did not participate to interviews. Consequently, we had to face strong resistance in convincing him accepting challenging problem formulations and, more generally, the complexity of local situations they usually perceive through an exclusive technical scope.

Step 2: Focusing on the objects

Each of the stakes and objects identified in the previous phase are further analysed to reveal potential connections with other stakes or objects. Thanks to experience gathered from the various cases, such investigations became easier as we get to know how local networks of stakeholders are structured. Furthermore, INERIS has been involved since 2007 in observing how the PPRT regulation is implemented and applied through various test cases. Lessons have been learned and some regular patterns have been observed regarding the complexity and interconnections of objects usually impacted by the PPRT.

For these reasons, the exploration of objects was performed relatively easily in the PPRT context.

To illustrate how this exploration was conducted, let's get back to the example of a railway and a train station potentially impacted by catastrophic consequences. *Risk prevention plans impose to protect both users of train stations (passengers on station platforms or inside stationary trains) and passengers of moving trains (crossing the hazardous area without calling the station).*

Decision alternatives can be risk reduction measures inside the hazardous site; reinforcing the train station buildings to protect its users; traffic stop (to avoid new train entering the impacted area after an accident, especially if the accident implies release of toxic substances) and evacuation procedures.

According to these elements, we suggest to the client to systematically consider the following stakeholders:

- *The Owner of the railway infrastructure: In charge of the maintenance of the infrastructure, he also sells a right to use to transportation companies. If the risk prevention plan limits the use of this infrastructure, the economic consequences may be important for him.*
- *Transportation companies using the infrastructure: Responsible for the safety of their passengers if an accident occurs.*
- *Owner of the train station: Responsible for the safety of the passengers on the platforms.*

- *Local authorities: Responsible of developing public transportation systems to increase the attractiveness of their territories.*

We can see here how one visible stake can put the light on a network of hidden stakeholders and stakes that could have stayed unrevealed until the beginning of the decision process.

Step 3: Assessment of participation types

The list of stakeholders elaborated at this level is analysed through the approach described in fig.6. Those with high level of competence are presented to the client as candidates to be interviewed in order to integrate their representations when organising the IS.

The various clients we had to deal with all shared a precautionary vision of who should be interviewed. Basically, instead of selecting the most competent stakeholders, clients insisted on the necessity to meet all identified stakeholders in order to avoid any negative reaction if a stakeholder feels he was neglected if not interviewed.

Lessons learned

This step was initially meant to ensure that problem representations of competent stakeholders were used to enrich the client's one. Experience shows that the client attaches different objectives and signification to this step. Actually, clients perceive this step as a precious occasion to meet stakeholders and show their openness and willingness to implement a real participative process. Furthermore, it was an occasion to present and detail the PPRT procedure that, because of its technical and administrative complexity, remained a mystery for several stakeholders.

As analysts, we did not oppose any resistance to this tendency for two main reasons. First, it was not in contradiction with the objective of interviewing competent stakeholders. Second, we had to acknowledge that the additional objectives defined by the clients for this step were as relevant as the competence objective we defined in theory.

Therefore, if the client is willing to invest enough resources, this step may also serve pedagogical objectives in addition to those associated to enriching client's problem representation.

Step 4: Collecting stakeholders' inputs

Stakeholders whose inputs are to be considered in order to organise the IS were interviewed individually. If the list of artefacts to be built was for us a constant driver of the interviews, discussions were kept open and all topics brought by the stakeholder discussed. We believe that this openness is justified for the following reasons:

- It reduces the likelihood of stakeholders developing hidden agendas.
- It reveals what we call *parasite objects*. Actually, issues to be treated by risk prevention plans are legally defined. For example, hazard materials transportation or noise pollutions are not in the scope of these decision processes. Those very same issues are very often on the top agenda of some stakeholders that expect to bring them within the IS. Such interviews are thus good occasions to clearly explain and justify why these objects cannot enter the IS. Furthermore, we usually suggest the

client to create separate IS dedicated to those objects in order to not having them disturbing or consuming resources of the ongoing decision process.

Lessons learned

Stakeholders' contributions have demonstrated to be extremely informative about the local context. In addition to what was expected in terms of problem representations, we identified some recurrent set of valuable contributions for the IS structuration:

- *Historical facts*. Prefets and their technical services lack knowledge about local history because of periodically changing (every 4 to 5 years) positions. Therefore, local stakeholders provide the IS with memories, historical facts and ancient or ongoing conflicts that contributed shaping the actual situation. Without this historical knowledge, it was very likely for the client to misinterpret or misunderstand future situation(s) and behavior(s) occurring within the IS.
- "*Opportunistic stakeholders" identification.* We refer here to stakeholders with no available trace of continuous visibility within the public sphere making it difficult to identify them or to assess whether they are still existing or just disappeared. Relying on local knowledge makes it easier to identify these potential stakeholders and get prepared in case of their re-emergence. *As an example, a PPRT was taking place in a context were a few years ago, an incinerator project has generated great outrage and led to the creation of a citizens association which disappeared as soon as this project finally has been withdrawn. The mayors warned us about the need to discuss the opportunity of including this association within the IS. Even if the association was actually dissolved, we warned the client that its reemergence was a risk to be tackled during the life cycle of the IS.*
- *Fostering trust and cooperation*. Stakeholders experiencing a DM interested in gathering their opinions and views before the official process starts definitely express more confidence and comfort in getting involved in the decision process.
- In many occasions, we felt that these preliminary interviews with stakeholder were conducive for the creation of a valuable and extremely useful trust capital.

Step 5: Organizing the set of objects

Regarding specifically the objects brought by stakeholders within the IS, we can distinguish two main types. Some objects are totally new regarding the client's representation. In this category, one can find for instance future projects that were not public yet but may be impacted by decisions to be taken during the PPRT. The second, and much more frequent, set of objects encompasses various related objects to those identified by the client or a reformulation of them. The second category was composed by objects reflecting partial but complementary understandings and formulations of common objects amongst the stakeholders.

Therefore, organising the set of objects was done in parallel to the objects' reformulation in order to integrate the variety of dimensions and perspectives expressed by the stakeholders.

To do so, workshops were organised with the client in order to discuss objects formulations and scheduling. Usually, it requires a full day to a day and a half to come out with a shared and acceptable organisation of the IS according to the criteria described previously.

Lessons learned

- This step was meant to organise the IS through scheduling of objects. Practically, we spent much more efforts reformulating the objects regarding the various collected contributions than really scheduling them. Our feeling is that the more objects are clearly formulated and understood, the easier is the scheduling.
- Workshops where good occasions for our client to build internally a shared representation of the problem situation and agree on a working plan.

  In some cases, it was also for them an occasion to communicate with their hierarchy on the complexity and the need to invest resources in preparing and implementing the participation process.
- Finally, these workshops were a necessary step to ensure that the knowledge, collected mostly by the analyst, was correctly and extensively shared and discussed with the various departments under the supervision of the client. Actually, this knowledge management became a central issue in our exchanges and led to the elaboration of "objects sheets" and "stakeholders sheets" summarising the core knowledge about objects and stakeholders. These sheets were meant for sharing and updating within the client's internal services.

Step 6: The IS as a learning tool

Once the IS is structured, a meeting with all stakeholders interviewed and the client is organised in order to present the proposed participation structure. We usually try to focus peoples' attention on the following points:

- Description of our understanding of stakeholders' representations and the way we integrated them within the participation structure.
- Description of what we believe as the added value of their contributions at this preliminary level of the decision process. In other words, we try to demonstrate how their contributions have already changed or influenced things.
- Description of the main tradeoffs discussed with the DM and the rationality behind them.
- Presentation of the participation model and how various representations and expectations fit within.

We have been invited a few times to revise some aspects of the structure. Nevertheless, most of the requests were related to providing more detailed planning, more precisions on what is expected from the various stakeholders as well as concrete deadlines.

When it was possible, such clarifications were provided. Nevertheless, it was important for us to explain that the suggested structure was not meant to be used as a rigid framework. It was highly recommended to regularly revise the structure as the decision process runs in order to adapt to the unavoidable evolution of the artefacts that result from the participation in itself.

Overall lessons learned

The lessons learned for each step detailed above have to be considered with the complementary following global observations:

- Trust in the DM was in most of times the biggest challenge to overcome. Actually, very few participative experiences have been previously conducted in those locations. The "Prefet" and his services were very often perceived as distant and not really in touch with local realities. Furthermore, the "Prefet" was considered as a "*too central*" figure regarding the multiplicity of his roles and responsibilities. Several times, local stakeholders asked for a mediator or an external third party to distinguish the decision maker from the IS organizer. Unfortunately, this possibility was not considered by the DM as viable and we had to consider it as a constraint in designing our participation structures.
- As described earlier, the 2003 Act on industrial and natural risks introduced simultaneously higher complexity in risk evaluation and higher process disclosure. The new entering stakeholders, namely local authorities and citizens, were not used to such procedures and had important difficulties engaging in technical discussions, especially when they had to deal with likelihood of risk scenarios.

  An important challenge for us was here to find an adequate balance between fairness and competence criteria regarding complex technical issues requiring specific expertise.
- Designing and managing a participative decision process was not always perceived as a professional activity requiring dedicated resources and expertise. Some clients as well as stakeholders considered it as an activity to be dealt with through natural qualities like charisma, listening abilities and empathy. If we consider those qualities as more than welcomed and necessary in participative contexts, we believe them as insufficient to answer the multiple challenges of public participation. Client and stakeholders' skepticism was thus a faithful companion of our interventions, at least at the beginning.
- Organising stakeholders' participation and facing directly the public was, in several cases, a totally new experience for our client, especially the technical services. Before the 2003 act, their role was centered on inspecting and evaluating safety performances of hazardous sites. Therefore, their external interactions were almost exclusively technical and oriented towards industry managers and engineers. Consequently, their top priority was the delivery of a correct and precise expertise, even if it was hardly understandable by other stakeholders or if this required long periods with no information delivered at all. This lack of (understandable) information was an important cause of mistrust and outrage, especially among the public.

  The participative structures we conceived in this context insisted on the need for regular information, even if it boils down in saying "we do not know yet".

Conclusions

This paper presents an original approach aiming at helping DMs to conceive adapted participative structures that respect simultaneously fairness, competence and efficiency requirements. Through the various artefacts described earlier, an analyst can suggest a well formalised product to a client; a product which design can be traced and performances assessed.

Furthermore, through a collaborative construction of the artefacts, the participative structure that will frame stakeholders contributions during the decision process is in itself the result of a participatory approach; making it more legitimate for participants and consistent with the reflexivity requirements of management science (Hatchuel,2000). Another remarkable aspect is the ability of the designers, being the analyst and the client, to demonstrate, before the initiation of the decision process, their willingness to cope with some quality criteria being fairness, competence and efficiency. Of course, satisfying these criteria will require in addition more efforts during all the decision process. Nevertheless, we believe that such a signal sent to the future participants sets the conditions for trust building.

Finally, we briefly described elements of Habermas' work regarding stakeholders' interactions and pretentions of validity in a way that serves the particular context of decision support. We believe that this discussion deserves further interest within the decision aiding community as an important interpretation and adaptation work is still to be done.

References

Ackoff (1979) The future of operational research is past. Journal of Operational Research Society (30), pp93-104.

Agarwal A (1995) Dismantling the divide between indigenous and scientific knowledge. Development and Change 26 (3), pp 413-39.

Aggens, L. 1983. Identifying different levels of public interest in participation. Fort Belvoir, VA: The Institute for Water Resources, U.S. Army Corps of Engineers.

Arnstein S R (1969) A Ladder of Citizen Participation in Journal of the American Planning Association 35 (4), pp 216-224

Bayley C, French S (2007) Designing a participatory process for stakeholders involvement in a societal decision. Group decision negotiation. DOI 10.1007/s10726-007-9076-8

Burns D, Hambleton R, Hoggett P (1994) The Politics of Decentralization: Revitalizing Local Democracy. Macmillan, London.

Checkland P (2004) Soft system methodology in principals In Rosenhead J, Mingers J (Eds) Rational analysis for a problematic world revisited, Wiley and Sons, UK, pp 61-90.

Chess C, Dietz T, Shannon M (1998) Who should deliberate when ? Human Ecology Review, 5(1), pp 60-68.

Connor D (1988) A new ladder of citizen participation. National civic Review 77(3):249-257.

Coote A and Lenaghan J (1997) Citizens' Juries: Theory into Practice. Institute for Public Policy Research (IPPR), UK.

Corburn J (2003) Bringing local knowledge into environmental decision making. Improving urban planning for communities at risk. Journal of planning education and research (22), pp 420-433.

Crosby N (1995) Citizens juries: One solution for difficult environmental questions. In: Renn O, Webler T and Wiedemann P (Eds) Fairness and Competence in Citizen Participation: Evaluating Models for Environmental Discourse. Kluwer Academic Publishers Dordrecht, pp 157-174.

Daniell K (2008) Co-engineering participatory modeling. Processes for water planning and management. PhD report. Australian National University.

Daniell K, Mazri C, Tsoukiàs A (2010) Real world decision aiding: a case of participatory water management. In French D, Rios-Insua (eds.) e-Democracy: a group decision and negotiation perspective, Springer-Verlag, Berlin, 177-208.

Dienel P C and Renn O (1995) Planning cells: A gate to "fractal" mediation. In Renn O, Webler T and Wiedemann P (Eds) Fairness and Competence in Citizen Participation: Evaluating Models for Environmental Discourse. Kluwer Academic Publishers Dordrecht, pp. 117 – 140

Eden C, Ackermann F (2004) SODA, the principals In Rosenhead J, Mingers J (Eds) Rational analysis for a problematic world revisited, Wiley and Sons, UK,, pp 21-41.

Fishkin J S (1995) The Voice of the People: Public Opinion and Democracy. Yale University Press, USA

Grundahl F (1995) The Danish consensus conference model. In Joss S and Durant J (Eds) Public Participation in Science: the Role of Consensus Conferences in Europe. Science Museum, London, pp. 31-40.

Habermas J (1987); Théorie de l'agir communicationnel. Edition Fayard.

Habermas J (1992) ; De l'éthique de la discussion. Edition Flammarion.

Hatchuel A (2000) Quel horizon pour les sciences de gestion ? Vers une théorie de l'action collective. In David A, Hatchuel A, Laufer R (Eds) Les nouvelles fondations des sciences de gestion. Edition Vuibert, pp 7-43.

ISO (2010) ISO 26000:2010. Guidance on social responsibility. ISO, Switzerland.

Keeney R (1992) Value focused thinking: a path to creative decision making. Harvard.

MAZRI C (2007), Apport méthodologique pour la structuration de processus de décision publique en contexte participatif. Le cas des risques industriels majeurs en France. PhD report, Paris-Dauphine University, France.

Laufer R (1996) Quand diriger c'est légitimer. Revue Française de gestion (111), pp 12-37.

LE MOIGNE J L (1990) Epistémologies constructivistes et sciences de l'organisation. In MARTINET A C (Ed). Epistémologie et sciences de gestion. Edition Economica, pp 81-140.

Nielsen A P & al (2006) Consensus conference Manual. LEI The Hague. www.ethicaltools.info/content/ET4%20Manual%20CC%20%28Binnenwerk%2040p%29.pdf. Accessed October 1st, 2012.

OECD (2001) Citizens as partners. Information consultation and public participation in policy making. http://www.ezd.si/fileadmin/doc/4_AKTIVNO_DRZAVLJANSTVO/Viri/Citizens_as_partners_handbook_oecd.pdf. Accessed October 1st, 2012.

Ostanello A, Tsoukias A (1993) An explicative model of public inter organisational interactions. European Journal of Operational Research, 70, pp 67-82.

Renn O (1999) A Model for an Analytic−Deliberative Process in Risk Management. Environment science and technology,33 (18): 3049–3055.

RENN O, KLINKE A (2002) A new approach to risk evaluation and management: risk based, precaution based and discourse based management. Risk analysis 22 (6), pp 1071-1094.

RENN O (2006); White paper on risk governance: Towards an integrative approach. IRGC publication.
http://www.irgc.org/IMG/pdf/IRGC_WP_No_1_Risk_Governance__reprinted_version_.pdf. Accessed October 1st, 2012.

Rosenhead J, Mingers J (2004) A new paradigm of analysis In Rosenhead J, Mingers J (Eds) Rational analysis for a problematic world revisited, Wiley and Sons, UK, pp 1-21.

Rowe G, Frewer L (2000) Public participation methods : a framework for evaluation science. Science, Technology and Human values 25 (1), pp 3-29.

Rowe G, Frewer L (2005) A typology of public engagement methods. Science Technology and Hum Values 30(2), pp 251–290.

Roy B (1985) Méthodologie multicritère d'aide à la décision. Edition Economica.

Roy B (1994) On operational research and decision aid. European Journal of Operational Research, 73, pp 23-26.

Roy B, Bouyssou D (1993) Aide multicritère à la décision: méthodes et cas. Edition Economica, Paris.

Roy B (2000) L'aide à la décision aujourd'hui: que devrait-on en attendre? In David A, Hatchuel A, Laufer R (Eds) Les nouvelles fondations des sciences de gestion. Edition Vuibert, pp 7-43.

Sandman P (1993) Responding to community outrage : strategies for effective risk communication. American Industrial Hygiene Association.

SCHÄRLIG A (1985) Décider sur plusieurs critères. Panorama de l'aide à la décision multicritère. Presses polytechniques et universitaires romandes, Lausanne

SFEZ L (1992) Critique de la décision. Presses de la fondation nationale des sciences politiques, Paris.

Simon H (1954) A behavioral model of rational choice. The quarterly journal of Economics (69), pp 99-118.

Tsoukiàs A., (2007) On the concept of Decision Aiding Process, Annals of Operations Research, vol. 154, 3-27.

Tsoukiàs A., (2008) From Decision Theory to Decision Aiding Methodology, European Journal of Operational Research, vol. 187, 138 – 161.

Van Dijk A T (2003) contextual knowledge management in discourse production. Proceedings of the conference of the society for text and discourse, Madrid, pp 256-286.

Watzlawick P, Beavin JH and Jackson DD (1967) Pragmatics of human communication. W.W.Norton, New York.

Weber M (1922) ; Economie et société. Edition Presses Pocket.

Webler.T (1995) Right discourse in citizen participation : an evaluative yardstick in Fairness and competence in citizen participation coordinated by RENN.O, WEBLER.T, WIEDEMANN.P, Kluwer Academic Press, pp 35-77.

Webler T, Renn O (1995) A brief primer on participation: Philosophy and practice In Renn O, Webler T and Wiedemann P (Eds) Fairness and Competence in Citizen Participation: Evaluating Models for Environmental Discourse. Kluwer Academic Publishers Dordrecht, pp 17-33.

Webler T, Tuler S, Kruger R (2001) What is a good public participatory process? Five perspectives from the public. Environment Management, 27(3), pp 435-450.

Wiedemann P, Femers S (1993) Public participation in waste management decision making: analysis and management of conflicts. Journal of Hazardous Materials 33(3), pp 355-368.